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13. Abstract ***(Maximum 200 Words)*** *(abstract should contain no proprietary or confidential information)*

Two Smithsonian organizations, the Monitoring and Assessment of Biodiversity Program (SI/MAB) and the Center for Tropical Forest Science (CTFS), continue ongoing research projects in Western and Central Africa. MAB and it partner organization in Cameroon, BDCPC, conducted a 10-day Biodiversity Assessment training course for Nigerian participants in an effort to understand the capacities of the Nigerian National Parks. With the support of MAB, biological assessment and monitoring at the Takamanda Forest Reserve, Cameroon will soon yield a series of publications.

The Center for Tropical Forest Science (CTFS) has completed the establishment of the 50-ha Korup Forest Dynamics Plot (KFDP). This research plot seeks to better understand forest dynamics and tropical forest ecosystems through analysis of forest biology, spatial distribution, and species identification. Current research efforts at KFDP have completed census data compilation and map digitization. The Korup plot has also yielded the discovery of a new species *Tricalysia achoundogiana* (Rubiaceae) and these findings were published in the journal Adansonia. Other ongoing projects of KFDP include complementary research projects on seedling demography and phenology. KFDP scientists have participated in both analytical workshops coordinated by the Center for Tropical Forest Science and presented their preliminary findings at the Association of Tropical Biology Annual Meeting 2002 in Panama.

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Foreward

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V. Introduction

The AP1 program of the Drug Development and Conservation of Biodiversity in West and Central Africa funds the studies on forest dynamics and demographics conducted by two Smithsonian organizations, the Monitoring and Assessing Biodiversity Program (SI/MAB) and the Center for Tropical Forest Science (CTFS). Over the course of the fourth year of funding under the ICBG grant, the MAB program has been active conducting a training course in Calabar, Nigeria, and a recensus of the biodiversity plots that were established in Cameroon in 1997. In addition, MAB is producing a series of papers based on the biodiversity assessment of the Takamanda Forest Reserve in Cameroon, that was conducted in collaboration with SI and various conservation organizations.

The Center for Tropical Forest Science has completed a 50-ha Korup Forest Dynamic Plot (FDP) in an effort to study forest plant diversity and dynamics across large spatial and temporal scales. The Korup Forest Dynamics Plot (KFDP) is a large-scale plot in CTFS' global network of eighteen standardized tree plots, each utilizing an identical methodology throughout all sites in the tropics of Asia, Latin America, and Africa. Within the 50-ha plot, all trees over 1 cm diameter have been tagged and identified to species. Data gathered from repeated censuses allow explorations into the maintenance of diversity and dynamics of the forest. The Korup Forest Dynamics Plot has completed collection and verification of the census data, along with digitization of field maps. The enumeration of lianas has been completed for the first 10 ha. Korup Forest Dynamics Plot project leaders attended two workshops of the Center for Tropical Forest Science Analytical Workshop Series. The purpose of these 3-wk workshops was to provide training of analytical skills to manage and manipulate the large datasets and to produce original publications which analyze forest dynamics at individual sites and compare cross-site dynamics and diversity.

VI. Project Activities

A. SI/MAB Biodiversity and Monitoring

1. Biodiversity Course in Nigeria

The MAB program, in collaboration with BDCP, conducted a training course on "Adaptive Management for Biodiversity Monitoring Assessment and Sustainable Utilization in West/Central Africa" in Calabar, Nigeria. The primary objectives of the training were to:

- Provide an overview of biodiversity and the need for regional assessments
- An overview of regional context of biodiversity
- Provide a methodology for vegetation assessment and monitoring
- Introduce GIS and its use in relation to biodiversity assessment
- Review the economics and sustainability of biodiversity

In addition, the course aimed to facilitate the exchange of information and experience sharing among participants, and to identify the current capacities and constraints of Nigerian national parks and community based projects. Ultimately, the goal is to provide the in-country participants with the capacity to conduct biodiversity assessments in areas considered to be of conservation importance. Participants from national parks, state forestry departments, and local NGOs attended the course. The activity was composed of four days of lectures and 6 days of field work. Lectures include background information on the ICBG, collaborating organizations, the importance of biodiversity, the need to conduct biodiversity assessments, case studies of work conducted in the region and elsewhere, medicinal and ethnobotanical approaches, community forest studies, as well as techniques for economic valuation. Field work provided participants with experience in the use of GPS equipment, plant collecting and identification techniques, and methods for establishing permanent vegetation monitoring plots.

2. Recensus of Biodiversity Plots in Cameroon

In 1997, MAB established five one-hectare biodiversity plots; two in Ejagham Forest Reserve and three in the Campo Faunal Reserve. Following the protocols established for monitoring these plots, we conducted the first recensus in May 2002 (remeasured every five years). Coordination of the field work was conducted by BDCP-Cameroon. All trees that had been previously marked and tagged were relocated and measured. Trees that had died in the intervening time were noted, while new trees that had attained the minimum diameter of 10 cm required for inclusion in the study were marked, measured, identified and tagged.

Preliminary analysis indicates that mortality exceeded recruitment at all three sites leading to a net decline in the density of trees in the five plots. The mortality rate was 1.62 ± 0.16 % per year (from 1.28 to 2.15% per year), while the recruitment rate was 0.88 $\pm$ 0.15 % per year (0.33 and 1.17% year). Turnover rates were higher in Ejagham (1.39 % per year) than in Campo (1.16% per year) indicating a more dynamic forest. Neither species richness nor diversity varied significantly at any of the sites. About 55% of the trees that died had a diameter smaller than 10 cm, a proportion that is comparable to other tropical forest sites around the world.

3. Floristics of the Takamanda Forest Reserve

In year 3 of the ICBG grant (FY 2001), ten biodiversity plots and 36 modified Whittaker plots were established in the Takamanda Forest Reserve along an altitudinal gradient. In addition, an extensive assessment of the area was conducted through collections outside the plots. Over the course of 2002, we have had the opportunity to prepare a manuscript for publication based on this information. The results can be summarized as follows:

- A total of 4,628 individual trees >= 10cm dbh were measured in ten BDPs, representing 351 species, 210 genera, and 58 families. Cumulatively, these trees had a mean dbh of 29 cm and a mean basal area of 30.8 m^2/ha;
- A total of 8,885 individuals, representing 442 species, 243 genera and 75 families were recorded on the Modified Whitaker plots;

- For the qualitative vegetation assessment, 861 voucher specimens were collected, representing 612 species, 277 genera and 91 families;
- In total, these 14,374 individual records represent 953 species, 504 genera and 113 families;
- The habitats sampled included lowland forest including riverine and secondary forest, lowland ridge forest, mid-elevational forest, montane forest, and high altitude grassland;
- Forty-seven species of conservation interest were recorded in the reserve.

B. Large-scale CTFS Korup Forest Dynamics Plot

1. CTFS 50-ha Korup Forest Dynamics Plot

The enumeration of the 50-ha Korup Forest Dynamics Plot (KFDP) was initiated in January 1997 and completed in July 1999, following the standardized methodology of the Center for Tropical Forest Science (CTFS) network of long-term research plots in tropical forests in Asia, Africa, and Latin America. The 50-ha plot was divided into 1250 quadrats of 20x20 m. and all free standing plants with dbh>1cm were mapped and identified to study forest dynamics and long-term research questions relating to distribution, density, and diversity in tropical forests. In July 2002, the census dataset was fully verified for accuracy. In addition, all field maps have been digitized and a CD should be produced early next year with a complete set of maps for the KFDP. Within the plot, there were 329,026 total trees of dbh >1cm. Fifty-nine families, 236 genera and 496 species were represented in this Forest Dynamics Plot. This complete dataset has enabled participants of the CTFS workshops to analyze the plant diversity and distribution associated with habitat types.

a. Field Checking

Field checking provides invaluable information which maintains the desired accuracy of the database between censuses. Throughout the year field visits have found trees in the plot to be dead, down, or untagged. The rainy season occurs between March and November (High Rainfall ~5200mm/year) thus restricting most field work to occur during the months of December to March. Field activities were limited to on-going data collection on phenology and seedlings, as well as further herbarium collections of fertile plants.

b. Discovery of a New Plant Species

Within the Korup Forest Dynamics Plot, project botanists have fully described one new species of *Tricalysia* (*Tricalysia achoundogiana Sonke, Robbrecht & Kenfack*). These findings will be published in the December 2002 issue of Adansonia as the following citation: Sonke B., Kenfack D. & Robbrecht E. A new species of the *Tricalysia atherura* group (Rubiaceae) from southwestern Cameroon.

c. Enumeration of Lianas

The challenging process of liana enumeration continued this past year. All lianas > 1 cm in diameter have been marked, measured, and mapped in 10 ha. A total of 7,384 stems have been measured, representing 272 species/morphospecies, 94 genera, and 33 families. The family Rubiaceae was the most represented family thus far, with approximately 70 species. Cataloging efforts continue for the complete enumeration of lianas in the 50 ha. KFDP.

The identification of the remaining unknown individuals will likely increase the overall taxonomic diversity of lianas in the plot. Present and future identification of lianas is aided by the collection of voucher specimens. During this past year, greater than fifty-two fertile materials were collected in two to six duplicates and will be housed in herbaria in Cameroon and internationally. We expect that lianas, as a group will be especially important in drug screening.

2. Training and Outreach

a. Center for Tropical Forest Science Analytical Workshop

Korup Forest Dynamics Plot scientists, David Kenfack, George Chuyong, and Duncan Thomas participated in a three and a half week long training course in July 2001 and another in July 2002. With a total of five workshops, covering basic analytical techniques coordinated by the Center for Tropical Forest Science, this team of scientists have been given the tools to produce a publication from the first KFDP census. The second workshop, hosted by the Smithsonian Tropical Research Institute in Panama from July 7 through July 29, convened over 30 scientists and data managers from the Center for Tropical Forest Science's network of 14 Forest Dynamics Plots located throughout the tropics. The analytical workshop aimed to further participants' skills to analyze spatial patterns and habitat associations of tropical forests using a program developed for all CTFS plots. Immediately following the workshop their findings were presented at the Association for Tropical Biology (ATB) Annual Meeting.

b. Presentation of Habitat Analysis

Dr. Chuyong's presentation at the ATB Annual Meeting entitled, "Habitat Specificity and Diversity in the Korup Forest Dynamic Plot, Cameroon" described the results and analysis preformed at the CTFS workshops. Overall the plot occupies a typically diverse terrain ranging from valley bottom to steep slopes and ridge top. A stream flows across the plot in the E-W direction. Habitats were defined using a combination of mean elevation, slope and convexity as topographic features of each 20x20 m quadrat. The following seven habitats have been identified in the KFDP:

- Riverside (4%)
  Quadrats with mean elevation <160m, slopes <15 degrees, convexity <0 and in contact with the main stream
- Low depression (21%)

Quadrats with mean elevation <160m, slopes <15 degrees, convexity =<0 and with small streams

- High gully (7%)
  Quadrats with mean elevation>160m, slopes < 15 degrees, convexity =<0
- Low flat (30%)
  Quadrats with mean elevation <160m, slopes < 15 degrees, convexity>0
- Bench (12%)
  Quadrats with mean elevation >160m<=200m, slopes < 15 degrees, convexity =<0
- Ridge top (7%)
  Quadrats with mean elevation >200m, slopes < 15 degrees, convexity <0
- Steep slopes (17%)
  Quadrats with mean elevation >200m, slopes >15 degrees, convexity <0

Dr. Chuyong noted that two major obstacles to monitoring forest dynamics are, first tropical forests may be comprised of many habitat types and second, most tree species in the tropics are rare and occur at low densities. Thus, knowledge of plant species association with a particular habitat can provide information on species-specific distribution, local extinction patterns, and community-wide changes in growth, mortality and turnover. These characteristics are necessary for describing forest dynamics in response to biophysical factors and providing information for models which can predict directional changes in the forest.

DIVERSITY WITHIN THE DIFFERENT HABITATS OF KFDP

Habitat type	Area (ha)	# of individuals	# of species
River	2.08	9,779	318
Low Depression	11.04	66,567	410
High gully	3.56	18,486	322
Low flat	11.24	117,972	439
Bench	6.08	42,876	356
Ridge top	3.32	21,012	290
Steep slope	8.69	52,268	362

Of the 310 species with more than 30 individuals, 211 showed significant positive associations with the different habitats (68%). Only one species was completely associated with the riverside. All others species were significantly associated with two or more habitat types.

Preliminary results indicate that a majority of the species in the plot, have clumped distributions, often positively or negatively associated with a range of habitat types. The riverside, low depression and low flat habitat types showed relatively higher species richness that can be attributed to lower moisture stress during the tough dry season.

Further research is required to understand the lack of correlation between species diversity and the different topographic variables, which may indicate that other site factors should be considered.

VII. Research and Training Accomplishments

- Local Nigerians participate in the MAB/BDCP 10 day Biodiversity Training Course held in Nigeria
- Completion of the recensus for the MAB 1-ha plots in Cameroon
- Final verification of KFDP census dataset and digitization of all field maps completed
- Continuation of phenology projects and herbarium collections at KFDP
- Participation in the second Center for Tropical Forest Science Analytical Workshop held in Gamboa, Panama.

IX. Reportable Outcomes

- Publication of biodiversity and assessment data from the Takamanda Forest Reserve by MAB
- Completed database of topography and species composition of 50-ha Korup Forest Dynamics Plot
- Plot digitization of topographic features available for the entire Korup Forest Dynamics Plot
- Discovery and publication of a new species in the *Tricalysia atherura* group (Rubiaceae) in 50 ha plot by Sonke B., Kenfack D. & Robbrecht E
- Presentation entitled "Habitat Specificity and Diversity in the Korup Forest Dynamic Plot, Cameroon" at the Association of Tropical Biology Annual Meeting using census and topographic data

X. Conclusions

The Monitoring and Assessing Biodiversity Program (MAB) continues to provide in-country participants with the capacity to conduct biodiversity assessments in areas considered to be of conservation importance through a series of training courses. Research at the Takamanda Forest Reserve has also yielded a series of publications detailing biodiversity in Cameroon and highlighting areas of conservation.

Research efforts at the 50-ha Korup Forest Dynamics Plot have completed a database of more than 300,000 species along with digitization of topographic features. This information permits researchers to understand the vectors of diversity and the dynamics of this tropical forest. Long-term forest trends also provide insight into species abundance, density, and population distribution over a variety of habitat types. The discovery of new species at KFDP provides a more complete view of niche requirements and competition in forest dynamic models, while providing more potential resources for medical research. Scientists from the Korup Forest Dynamics Plot, over the next four

years, will be active participants in the Analytical Workshop Series coordinated by the Center for Tropical Science for its network of demographic tree plots. The training at these workshops has already provided participants with the basic skills necessary to continue data analysis and management currently employed at the site. Overall, the research and training activities at Korup have moved beyond the foundation of great basic research and are on the verge of transitioning into the phase where great findings are contributed to the greater scientific community.